Lecture 2

Concrete, Components; Concrete properties, Tests and Specifications

CONCRETE:

- Definition & History
- Characteristics of Concrete
- Classification of Concrete
- Concrete as a Material
- Concrete Components
- Concrete Mix Design and Production
- Concrete Curing
- Properties
- Tests and Specifications

Defn. & History:

- Any mass or product made by the use of a cementing medium – product of reaction between hydraulic cement and water

- forms the basis of our modern society
- as old as the manufacture of cement and cementitious materials

Characteristics:

- Should have required compressive strength
- On hardening should exhibit minimum shrinkage
- Must be adequately dense
- Should be economical
- Must be adequately durable
- Should have minimum thermal expansion
- Should provide the required finish
- Should have sufficient water tightness
- Should have minimum creep

Classification of Concrete: According to design,

- Plain cement concrete
- Reinforced cement concrete (RCC)
- Pre-stressed cement concrete (PCC)

According to purpose

- LW concrete, for precast struc. Units for partition and wall lining
- Cellular or aerated concrete, for roof slab, precast units, heat and sound insulation
- Sawdust concrete, for heat and sound insulation
- Vacuum concrete, for extra strength in rcc
- White & coloured concrete, for ornamental, road parking
- High early strength concrete, construction in cold weather
- No-fines concrete, saves cement, good insulator for sound, does not segregregate

Concrete as a Material:

In its fresh state concrete should be satisfactory for

- Workability
- Placeability
- Compactibility

In its hardened state concrete should be satisfactory for

- Strength
- Low shrinkage and creep
- Durability

Concrete Components: 1. Cement 2. Sand (FA) 3. Coarse agg. 4. Water

Functions of cement: fills voids, binds aggs. And imparts strength

Functions of sand: fills voids, assists in hardening cement, minimizes shrinkage

Functions of CA: acts as main filler, imparts strength, balances shrinkage and vol. change

Functions of Water: wets, lubricates, carries cement, hydrates and imparts strength

Characteristics of Concrete:

- Fresh concrete [soft condition during manufacturing]
    - Segregation – separation of components resulting non-uniform mix
    - Bleeding—appearance of water on the surface resulting weak, porous concrete
    - Consistency – degree of fluidity or mobility or wetness
    - Workability – amount of work required to place concrete and to compact it thoroughly and depends on the factors,
        - Water content
        - Agg. Mix proportion
        - Aggregate properties
        - Admixtures
- Hardened concrete
    - Strength
    - Durability
    - Permeability
    - Elasticity & creep

Factors affecting the strength and durability properties of concrete:

- Water-cement (w/c) ratio
- Grading of aggregate (shape, size, surface texture, strength)
- Moisture content (m/c) of aggregate
- Quality of cement, sand and water
- Method of mixing, transportation, placing and compaction
- Curing

Measurement of Workability:

Workability can be measured by – slump test, compacting factor test, flow test etc

Slump Test

- A 30cm high cone with 10cm and 20 cm dia top and bottom opening is placed on a smooth surface and filled with fresh concrete in four layers
- Each layer is tamped with 25 strokes by a 16mm dia and 60cm long bull nosed steel rod and the top surface is struck with a trowel
- Immediately after filling, the cone is slowly lifted while the unsupported concrete will slump. The decrease in the height of the highest part of the slumped concrete is 'slump'
- Recommended slump values depend on concrete types as low as 10-25 mm for vibrated concrete to as high as 75-125mm for congested reinforcement and where vibration is not possible [columns, retaining walls, thin vertical sections]
- Slump test is very useful on site for checking variation in concrete workability

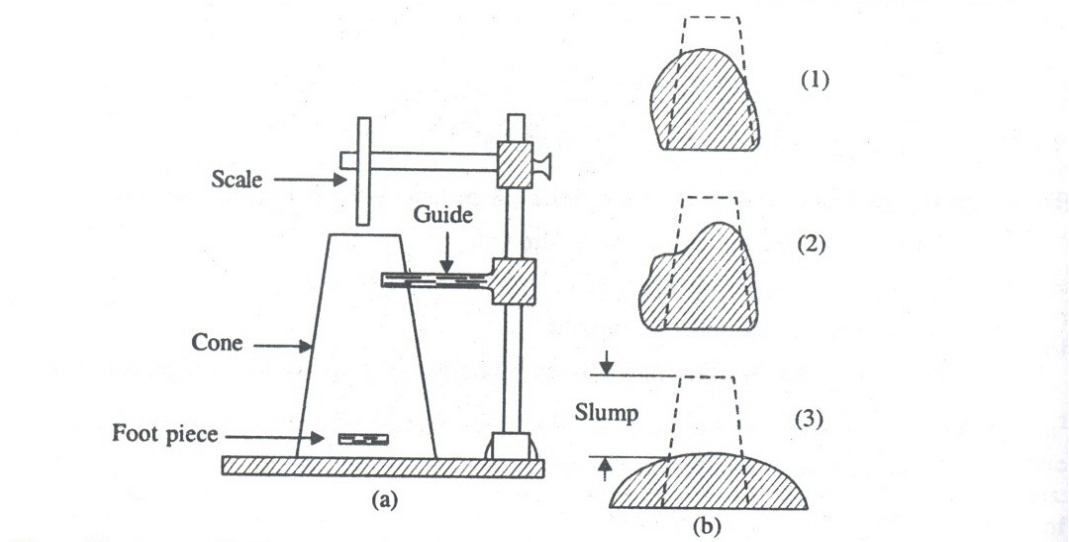


Fig. Slump test (a) Slump cone (b) Different types of slumps (1) true slump (2) shear slump (3) collapse slump.

Curing of Concrete

- Curing is the procedure for promoting hydration of cement during early stages of hardening.

- The objective of curing is to keep concrete saturated so that hydration proceeds at a maximum rate

Methods of Cruing:

- Water curing: most widely used method which involves in supplying additional moisture and prevention of moisture loss. Supply of water can be accomplished by ponding, spraying, sprinkling or use of saturated covering.

- Sealed/membrane curing: involves prevention of loss of moisture. Water proofing papers, polythene and plastic sheets, curing membranes are most widely used materials for sealed curing

- Steam curing: it is done in closed chamber, especially for precast concrete

Concrete Production: Production of good concrete also depends on,

- Mixing of concrete – types, hand and machine mixing, 1 min for 1 m^3 plus ¼ min for add 1m^3, or 20 revolutions of mixer per batch

- Transportation of concrete –must be transported to the place of final placement ASAP by a suitable method [by buckets or by pumps] so that segregation does not occur

- Placement of concrete –should be placed in its required position and should not be thrown or dumped from distance, in layers which will follow one another

- Compaction of concrete – process of consolidating concrete after placing in position, manually by steel rod and mechanically by using vibrators

Testing of Concrete:

- On fresh concrete
  - Workability
  - Wet unit weight

- On hardened concrete

- Laboratory tests
  - Compressive strength
    - On cylinders, 100mmx200mm, 150mmx300mm
    - On cubes, 100mm, 150mm
  - Tensile strength
    - Split cylinder test
    - Flexure test on beam
  - Pull out tests

- Field tests
  - On cores of 50mm, 75mm, 100mm diameter

- Non-destructive tests of concrete
  - Rebound test – to estimate compressive strength
  - Dynamic or vibration tests – to estimate strength and elastic properties
  - Radioactive or nuclear methods – to determine moisture and cement content
  - Magnetic or electric methods – to determine cover, reinforcement, thickness etc

Specifications:

Questions:

What is concrete? What are the characteristics of good concrete?

What are the components of concrete and their functions?

What are the factors affecting the properties of concrete?

What is workability? How do you measure workability?

Why is curing needed? What are the methods?
